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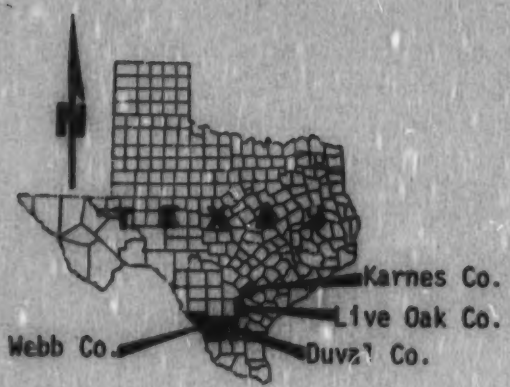

U. S. Environmental Protection Agency
Region VI
S. & A. Division - Houston Branch
Houston, Texas 77036

October, 1975

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Recent investigations of uranium mining and milling operations in the Grants Mineral Belt of New Mexico found serious environmental problems to be associated with these activities. The purpose of this investigation was to determine whether or not similar problems existed in the South Texas uranium belt. The investigation showed that these problems did not exist. Activities included in the investigation were (1) a literature search to gather background information; (2) a search of the files of state environmental regulatory agencies to assemble pertinent data; (3) an aerial and surface reconnaissance of the area involved and (4) discussions with involved persons in both the governmental and private sectors.

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ENVIRONMENTAL ASPECTS OF URANIUM MINING AND MILLING IN SOUTH TEXAS

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October 1975

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ABBREVIATIONS

EPA	United States Environmental Protection Agency
mg/l	milligrams per liter
pCi/l	pico curies per liter
TWQB	Texas Water Quality Board
TDHR	Texas Department of Health Resources
USGS	United States Geological Survey
USPHS	United States Public Health Service

I. INTRODUCTION

Background

Texas is the most recent State to become a major producer of uranium. Early exploration in western Texas did not reveal significant deposits; however, late in 1954, uranium deposits were discovered, quite by accident, in an environment previously considered unfavorable. Along a 300 mile belt from East-Central to South Texas, as many as 25 prospects were discovered in the upper Eocene to Pliocene rocks.

Extensive exploration followed. Airborne radiometric surveys were conducted by oil, mining and exploration companies. The U.S. Geological Survey explored a 70,000 square mile area and published both airborne and surface radiometric maps. It is estimated that the South Texas uranium district contains about 5 percent of the U.S. proven reserves of this metal.

Open pit mining began in 1960 in a cluster of shallow (less than 50 feet deep) oxidized ore bodies in Karnes County. Milling operations soon followed. Deeper unoxidized ores were located in 1963 at a depth of about 100 feet and open pit mining of these deposits began and is continuing today. Even

deeper ore bodies between 200 and 400 feet have now been located by drilling and logging and production from these deposits using in-situ solution mining techniques is currently underway.

Early uranium mining and milling operations were carried on with virtually no environmental controls. In 1961, the Texas State Department of Health conducted sampling of surface waters to determine whether tailings ponds at the newly opened uranium mill were holding the tailings solution. Further sampling of privately owned wells was conducted in the 1960's to investigate complaints and to establish background levels of radioactivity in these ground waters. Such investigation is continuing.

The Texas Water Quality Board began regulation of open pit uranium mines in 1973 through provisions of the Texas Solid Wastes Act and the Texas Water Quality Act, and regulates uranium milling operations through "no discharge permits" and solid wastes registrations.

Purpose and Scope

Recent investigations of uranium mining and milling operations in the Grants Mineral Belt of New Mexico found serious environmental problems to be associated with these activities. The purpose of this investigation was to determine whether or not similar problems existed in the South Texas uranium belt.

Activities included in the investigation were (1) a literature search to gather background information; (2) a search of the files of state environmental regulatory agencies to assemble pertinent data; (3) an aerial and surface reconnaissance of the area involved and (4) discussions with involved persons in both the governmental and private sectors.

Acknowledgements

The cooperation of many persons and agencies is gratefully acknowledged. Special appreciation is expressed to the following:

1. Texas Water Quality Board, Austin, Corpus Christi, and San Antonio, Texas.

2. Texas Department of Health Resources, Austin, Texas.

3. Texas Water Development Board, Austin, Texas.

4. Bureau of Economic Geology, the University of Texas at Austin, Austin, Texas.

5. U.S. Geological Survey, Water Resources Division, Austin, Texas.

6. The University of Texas Health Science Center at Houston, Houston, Texas.

7. The Atlantic Richfield Co., Corpus Christi, Texas.

8. The Conquista Project, Falls City, Texas.

II. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

1. The existence of commercial grade uranium ore deposits in South Texas was discovered in 1954.
2. Mining of uranium ore in South Texas began in 1960 and was followed in 1961 by the installation of a mill to process the ore into yellow cake, U_3O_8.
3. The South Texas uranium district has become a major source of this metal and consists of about 5 percent of the U.S. proven reserves.
4. Uranium deposits in South Texas comprise relatively small and unrelated roll front masses exhibiting sharp boundaries.
5. Early found surface and near surface deposits of oxidized ore have been mined out.
6. Several known unoxidized ore bodies shallow enough to be mined from the surface remain and opportunities exist for reworking and extending some of the earlier mines.
7. South Texas uranium ore deposits at depths uneconomical to mine from the surface are

not amenable to tunnel mining, but are possible to mine in-situ using a solution mining leach process comprised of injection and producing wells.

8. Environmental monitoring and regulation of uranium mining and milling in Texas began early (1961), has progressed satisfactorily and is continuing.
9. Radiochemical levels of some Texas public water supplies are elevated; however, most of these are not in the active mining area and are due to natural levels of activity in the ground water.
10. Toxic metals, especially arsenic, molybdenum and selenium occur in varying degrees in conjunction with uranium ores in South Texas; however, environmental monitoring has shown no large concentrations in either surface or ground water of the area.
11. Abandoned, mined out open pit uranium mines scar the landscape of the South Texas uranium mining area and no regulatory institution for full reclamation of these mines exists.
12. The Texas Surface Mining and Reclamation Act which becomes effective on January 1, 1976 specifically addresses the reclamation of uranium mines which are opened after the enactment date of the Act, June 21, 1975.

Conclusions

1. Uranium deposits in South Texas will continue to be exploited since this metal is needed to fuel the ever increasing numbers of nuclear fueled electric power plants.
2. Deeper uranium ore bodies in South Texas will be mined using in-situ solution mining techniques.
3. The environmental impacts of uranium mining on South Texas have been relatively minor due to timely surveillance and regulation of the industry by the State agencies, especially, the Texas Department of Health Resources and the Texas Water Quality Board.
4. The waters impounded in abandoned mine pits are generally highly mineralized and unfit for legitimate water uses; however, available data indicate that they do not pose a radiation threat.
5. Reclamation of abandoned uranium mines is either non existent or is at best minimal. Erosion, both by water and air, of the overburden piles is predominant problem.

6. Short of complete reclamation (backfilling), the Texas Water Quality Board requirements for overburden slope treatment and seeding, coupled with grading to channel mine area runoff into the open pit, appears to be generally environmentally acceptable, except for the impoundment of water and scarring of the landscape. These requirements are not applied to the early abandoned mines.
7. The Texas Water Quality Board ground water monitoring, closing and restoration requirements for in-situ solution mines are thorough and theoretically adequate. In the final analysis, only experience will prove their effectiveness in protecting ground water in these areas.
8. The newly passed Texas Surface Mining and Reclamation Act will provide the institution to environmentally control open pit uranium mining and mine restoration in mines opened after June 21, 1975. It specifically exludes mines opened and/or abandoned prior to the enactment date of the legislation and therefore will not control the 38 presently abandoned and operating mines.
9. There are no data concerning air pollution and the possible intermedia transfer of airborne pollutants from uranium mining operations.

Recommendations

1. That the Texas Water Quality Board obtain additional data on the possible toxic metal (As, Mo, Se) contamination of surface runoff from those abandoned mines having no erosion and surface drainage controls. These are the 12 abandoned mines formerly operated by Susquehanna-Western, Inc. which have not reverted to other ownership; the two mines in Live Oak County belonging to Exxon U.S.A. and those mines of the Conquista Project which have not been or are not now being reclaimed.
2. That the Railroad Commission of Texas, in promulgating rules and regulations implementing the Texas Surface Mining and Reclamation Act, consider complete backfilling and restoration of mines opened after the enactment date of the Act as the reclamation method of choice to prevent environmental problems and to minimize the aesthetic degradation of lands affected by surface mining.
3. That the Texas Air Control Board thoroughly evaluate the extent and nature of airborne pollutants resulting from uranium mining operations including those from abandoned mines, and coordinate with the

Texas Department of Health Resources and the Texas Water Quality Board in analysis of airborne particulate samples for radionuclides and toxic metals.

III. DESCRIPTION OF THE STUDY AREA

Location

The uranium producing belt is located in South Texas. It lies in a northeast to southwest direction and is centered in Karnes, Live Oak, Duval and Webb Counties between San Antonio and Corpus Christi. Natural vegetation consists of small trees, shrubs, cactus, weeds and grasses. Principal plants are mesquite, small live oak, post oak, prickly pear cactus, catclaw, blackbrush, whitebrush, huajillo, huisache, cenizo and other subtropical dryland vegetation, which often grow very densely, especially along ridges and streams.

Principal streams draining the study area are the San Antonio and Nueces Rivers.

Climate

The climate of the area is characterized by moderate rainfall (19-32 inches/year), a long growing season (280-320 days), and mean annual temperatures ranging from 70°F to 72°F.

Economy and Population

The economy of the area is rural and agricultural in nature; however, discovery and production of oil, gas and uranium has brought about some industrialization. It is

located between two major trading areas, San Antonio and Corpus Christi, which serve as headquarters cities for the industries and receiving points for their products.

Neither the oil nor the uranium industries are employee intensive; therefore, a rural agribusiness community, superimposed over these industries continues to prevail. With the exception of a small cadre of experienced personnel brought in to oversee industrial operations, most people employed in these industries are of local origin. Most of the labor force continues to operate family owned farming and ranching enterprises and associated service industries.

The population of the four county study area is estimated to be approximately 105,000 persons, most of which are located in the Laredo area of Webb County, physically outside the uranium producing district. The actual population of the uranium producing area is about 32,000 persons.

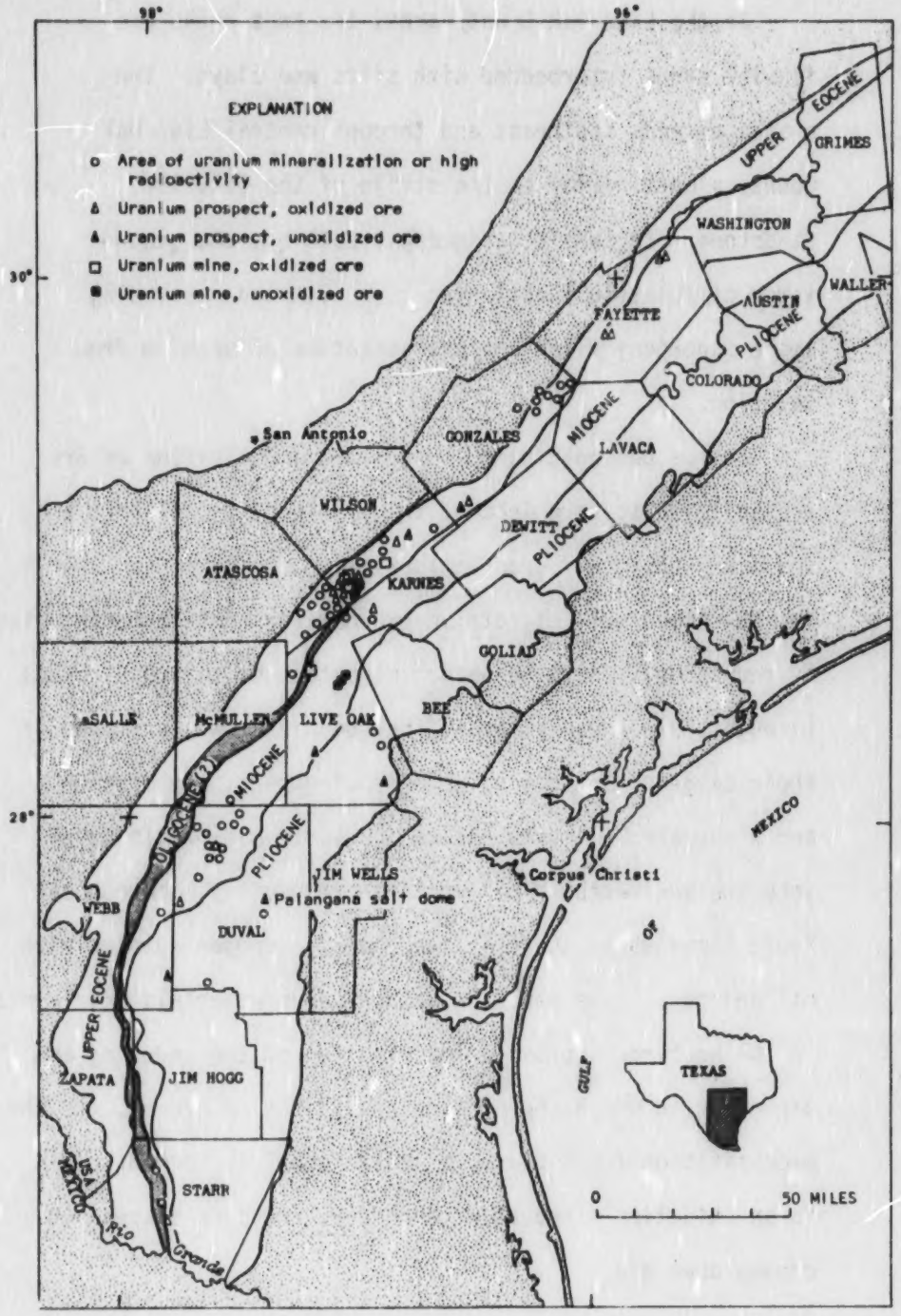
IV. OCCURRENCE OF URANIUM ORE

Geology

The South Texas uranium deposits are found in the gently dipping late Eocene to Pliocene sedimentary beds on the northwest flank of the Gulf Coast geosyncline. The strike of these sedimentary beds approximately parallels the shoreline of the present Gulf of Mexico (See Figure IV-1).

The host rock for uranium is tuffaceous, arkosic sandstone enclosed in tuff, tuffaceous zeolitic mudstone, clay and lignite beds. The sands are interbedded with bentonitic clays and tuffaceous silts that in some localities are almost pure volcanic ash.

The Eocene rocks of the Karnes County area contain considerable amounts of carbonaceous material and thin beds of lignite. The sands are shallow marine deltaic lagoonal and barrier bar deposits laid down near shores and extending out to continental shelves. These are cyclic deposits interbedded with carbonaceous swamp deposits and with fine textured water laid ash of acid volcanics. Some of the beds contain thin shelled fossil assemblages of few species which indicates a brackish lagoonal environment similar to the bays of the modern coast.



Map showing areas of mineralization, prospects and uranium mines in the Coastal Plain of South Texas.[After Eargle,(1970)]

FIGURE IV-1

In the Live Oak County area, the host rocks are fluvial sands interbedded with silts and clays. The system extends southeast and through central Live Oak County almost normal to the strike of the Oakville Sandstone. In this stratigraphic setting, the ground water circulation is believed to be limited, providing ample opportunity for the precipitation of uranium from solution.

In the geologic past, oxygenated and alkaline waters are believed to have leached the uranium from volcanic ash and other sources. Uranium is highly soluble as the uranyl ion UO_2^{2+} and will migrate in groundwaters until precipitated by reduction. As these waters migrated the tortuous routes through the permeable sands, they became slowly stripped of their oxygen. In this reducing environment, the uranium and associated elements became insoluble and precipitated into the sediments. The deposits are usually located near fault lines where there is seepage of hydrogen sulfide rich oil and gas. This plus the carbonaceous materials and lignite in the host rocks provide for creation of the reducing environment in which the uranium precipitation occurs. As the precipitation takes place, a "roll-front" is formed. This is an oxidation - reduction boundary, crescent shaped and convex down dip.

The early near-surface and outcropping oxidized ores mined in Karnes County were small lenticular bodies of high grade ore surrounded by lower grade ore. It is believed that these deposits were oxidized remnants of unoxidized roll-front deposits from which most of the overburden was removed by erosion.

The unoxidized roll front deposits occur at or below the current water table. The ore body boundaries are very sharp with the richest and thickest ores occurring on the downdip side. These deposits can be as thick as 25 feet.

In the Live Oak County area most oxidized deposits lie along the Oakville and related faults where more impervious beds mark the downdip limit of the ore bodies. Oxidized as well as unoxidized ores have also been found within and in association with sandstone filled fluvial channel systems.

Further south in Duval and eastern Webb Counties, uranium prospects are more varied in geologic setting. These located ore bodies are found in association with faults, grabens, filled channels and even salt domes.

It is important to note that uranium ore bodies in South Texas comprise relatively small independent, unrelated masses.

Discovery and Exploration

The initial discovery of uranium in South Texas was made during a 1954 radiometric airborne survey seeking to determine

whether atmospheric radon levels would lead to oil discoveries. The radioactive anomalies so detected led to the discovery of a surface deposit of oxidized ore.

Airborne radiometric exploration by both fixed and rotary winged aircraft in behalf of private interests as well as the Federal Government (U.S.G.S.) covered the entire area. These surveys were supplemented by other airborne imagery, geochemical, soil, water and air surveys, trenching, boring and logging.

The primary field exploration technique for uranium today is analysis of drill cuttings brought to the surface during boring operations. Generally the first indication of significant uranium is a color change associated between the oxidized sediments on the up-dip side and the reduced sediments on the down-dip side of uranium deposits. Since water is used as the drilling medium, drill cuttings are not reliable for analysis of uranium content. When highly anomalous activity is indicated on gamma ray-logs, offset holes are generally drilled and analysis is conducted on solid cores taken from the anomalous section.

Usually, exploratory drilling is not carried beyond the salt-fresh water interface, because of the additional costs that would be incurred in completing such holes to properly protect the fresh water aquifers from saline pollution.

V. COMMERICAL RECOVERY AND PROCESSING OF URANIUM

General

Two years after the original 1954 discovery of uranium deposits in South Texas, about 25 prospects were discovered along a 300 mile strip extending from east-central to southernmost Texas. (See Figure IV-1). Actual mining operations began during 1959 and 1960 and continue today.

During this period more than 20 companies including the following have been active in exploring and/or mining the region.

Gulf Oil Co., Nuclear Fuels Division
Exxon, U.S.A.
Amarillo Minerals, Inc.
Homestake Mining Co.
Susquehanna-Western, Inc.
United Nuclear Corporation
Kerr-McGee Corporation
Bear Creek Corporation
American Metal Climax, Inc.
Southland Royalty, Inc.
Continental Oil Co.
Pioneer Nuclear, Inc.
Sunray DX Co.

Tenneco Oil Co.

Union Carbide

Mobil Oil Co.

Atlantic Richfield Co.

Wyoming Mineral Co. (Westinghouse)

DALCO

U.S. Steel Co.

The first mining was in Karnes County for oxidized ores from shallow pits that averaged 40 feet in depth. In 1961, Susquehanna-Western, Inc. completed construction of a mill at Deweesville, near the mines and began processing ore at a rate of 200 tons per day. New impetus for exploration came in 1966 as nuclear fission became competitive with the fossil fuels as the energy source for electric power generation. During this time a second mining area in Live Oak County near Three Rivers was opened and a second mill was constructed by Susquehanna-Western, Inc. in 1970 at Ray Point to process this new ore. In addition another mill was constructed in Deweesville in 1972 by the Conquista Project, a joint venture of Conoco and Pioneer Nuclear, Inc. and the original Susquehanna-Western mill at Deweesville had been expanded during 1967.

At its peak, processing capacity in the region had expanded to 3,750 tons of ore per day, and uranium recovery exceeded 5 tons per day.

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Sunray DX Co.

Tenneco Oil Co.

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At its peak, processing capacity in the region had expanded to 3,750 tons of ore per day, and uranium recovery exceeded 5 tons per day.

Due to changing market conditions and other considerations, Susquehanna-Western, Inc. ceased operations at its two mills, so that by late 1973 only the Conquista Project mill was operating. This mill continues to operate today and processes between 2100 and 2300 tons per day of ore on a dry weight basis.

As the shallower ores became depleted and ores at depths greater than is practical to strip mine were discovered, in-situ solution mining techniques were tested and developed through pilot plant operations. At the present time, one such unit being operated by the Atlantic Richfield Co. is on line near George West in Live Oak County and another near Bruni in Webb County is under construction by Wyoming Minerals Co. (Westinghouse). Wyoming Minerals also operates two pilot projects utilizing this technique and Atlantic Richfield expects to increase its capacity from a present 250,000 pounds per year of U_3O_8 to something over 1,000,000 pounds per year.

Open Pit Mining

As was previously stated, the original mining in the region was particularly adaptable to the strip or open pit technique since the ore bodies lay near the surface. In this mining procedure topsoil and overburden are stripped off, and piled near the pit, the ore is removed and stored on an

"ore pad" near the mine for future delivery to a mill. When all of the ore is removed, the mine is abandoned.

Since 1973, this mining procedure has been modified to prevent problems that developed from the early operations. Stripped topsoil is conserved to cover exposed overburden piles and then seeded to prevent erosion. Ore pads are thoroughly removed and ore tailings are stripped from the pads and returned to the mine pit. Grading and diking of the mine area is accomplished so that local surface drainage is back to the pit.

In Situ Solution Mining

This process, greatly simplified, consists of injection of oxygen rich waters into the ore body sands to dissolve the uranium and withdrawal of this liquor through an adjacent well. In practice various geometric patterns of injection and producing wells are established. The uranium rich ("pregnant") liquor is stripped by solvent extraction or ion exchange and the "barren" water is reoxygenated and returned to the formation. This recirculation process is continued until the recoverable uranium in the well pattern is exhausted.

This technique is especially well adapted to the deeper Texas ores which exhibit high permeability. This same characteristic makes tunnel mining infeasible and the depths of

these ores makes strip mining uneconomical.

Milling Process Description

Milling of uranium ore can be broken down into the following unit processes: (1) leaching; (2) stripping; (3) precipitation, and (4) drying. For solution mining, the leaching process is carried on in-situ.

Depending on the characteristics of the ore either acid or other solution loops can be used for the leaching process. As an example, ores high in carbonates such as are found in portions of Live Oak County are amenable to a carbonate leach process. This process was used at Susquehanna-Western's Ray Point Mill while it was operational. On the other hand, low carbonate ores are generally leached with acid. Acid loop mill examples are the now closed Susquehanna Western Mill at Deweesville and the operational Conquista Project mill also at Deweesville. In either leaching procedure, an oxidant is added to oxidize the uranium.

Stripping of the pregnant leachate is generally accomplished by using either an organic solvent or ion exchange resins. In the case of the Conquita Project mill at Deweesville, a kerosene based organic solvent is treated with ammonium chloride. At the Atlantic Richfield solution mining leach plant at Clay West, the ion exhange column is treated with sodium chloride for elution (stripping) of the uranium.

Precipitation of the uranium product, U_3O_8, (yellow cake) is accomplished by the addition of ammonia (NH_3) at the Conquista Mill and by the addition of caustic (NaOH) at the Atlantic Richfield Leach Plant.

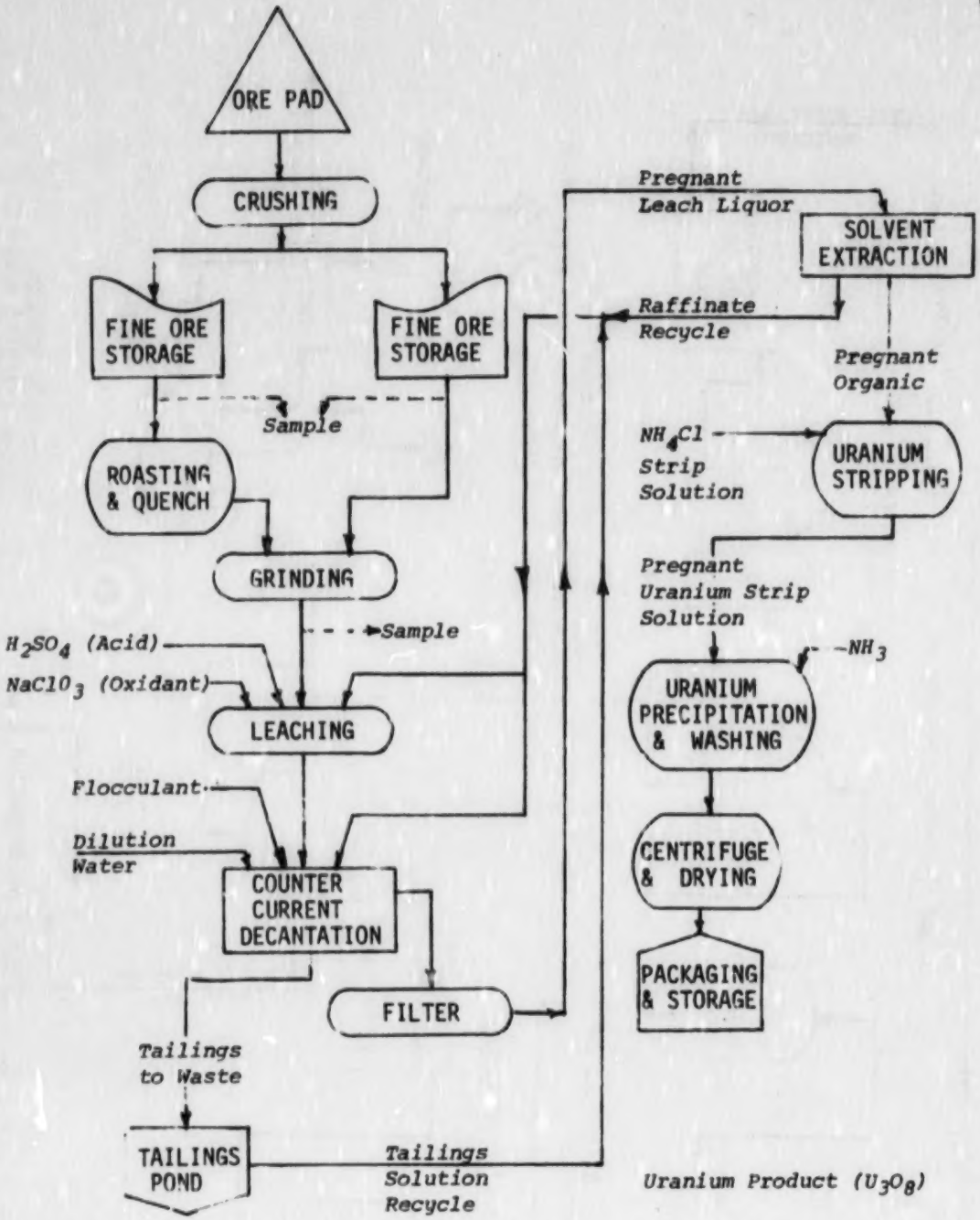
The precipitant is physically filtered or centrifuged and then dried in a gas fired dryer to about 2 percent moisture.

The dried yellow cake is then pulverized and loaded into 55 gallon drums with the aid of a vibrator. Properly filled drums contain 900 to 1000 pounds of the U_3O_8 product.

Flow diagrams of the Conquista Project Mill and the Atlantic Richfield Leach Plant are shown in Figures V-1 and V-2 respectively.

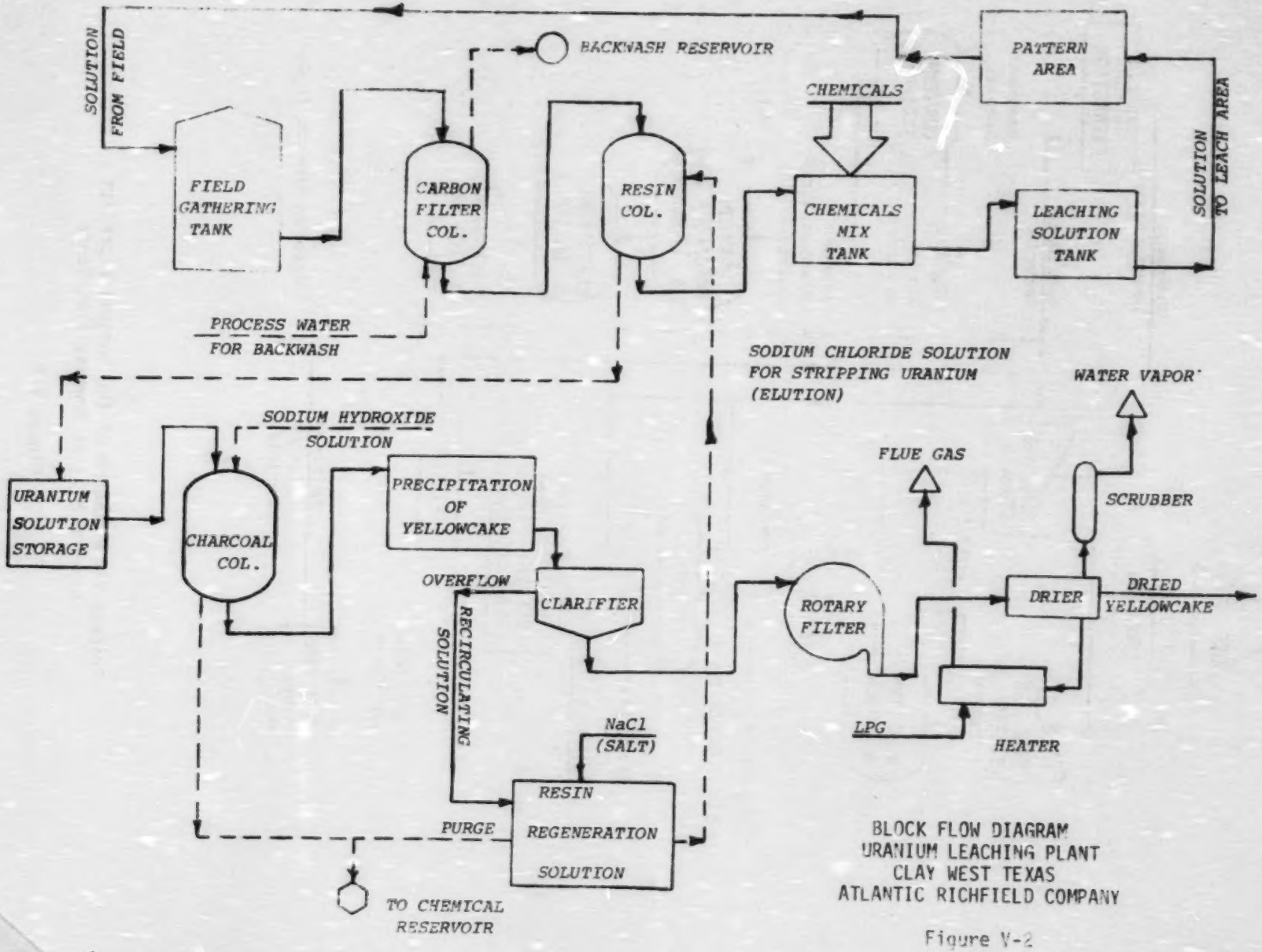
Current Status of Uranium Mining and Milling Operations

The current status of uranium open pit mining operations is shown in Table V-1. The current status of uranium solution mining operations is shown in Table V-2.



Process Flow Diagram of the Conquista project
Uranium Mill at Deweesville, Texas

Figure V-1



BLOCK FLOW DIAGRAM
URANIUM LEACHING PLANT
CLAY WEST TEXAS
ATLANTIC RICHFIELD COMPANY

Figure V-2

V-69

Table V-1

Uranium Open Pit Mines
Activity as of June 20, 1975

Ownership	Mine Name	TWQB Registration No.	Location: County	Status
Conquista Project	Haase	20619	Karnes	MO
	McGrady	20535	Karnes	MO
	Pfeil	20536	Karnes	MO
	Kellner	20530	Karnes	MO
	Lauw	20531	Karnes	MO
	Pawelek	20532	Karnes	MO
	Smith	20618	Live Oak	MO
	Turner	20617	Karnes	MO
	Manka	20616	Karnes	MO
	Dobie	20606	Live Oak	MO
	Ryun	20533	Live Oak	MO
	Weddington, S	20726	Karnes	MO
	Esse	20683	Live Oak	M
	Searcy	20704	Karnes	MO
	Beicker	20713	Karnes	MO
	Sickenius	20722	Karnes	MO
	Stoeltze	20534	Karnes	M
	Weddington, N	20726	Karnes	M
	Brown	20718	Karnes	M
	Rosenbrock	20733	Karnes	S
	Thomas	20736	Karnes	S
	Kotzur	20754	Karnes	N
	Moczygemba	20766	Karnes	N
	House	-	Live Oak	N
Susquehanna-Western, Inc.	Brysch, F.		Karnes	MO
	Brysch, I		Karnes	MO
	Wurzbach		Karnes	MO
	Galen		Karnes	MO
	Butler		Karnes	MO
	Glasscock		Karnes	MO
	Nuhn-Korzekwa		Karnes	MO
	Bargman		Karnes	MO
	Hackney		Karnes	MO
	Hackney Boso		Karnes	MO
	Kopplin		Live Oak	MO
	Mabel		Karnes	MO
Exxon USA	McLean		Live Oak	MO
	Felder		Live Oak	MO

Legend

MO = Mining Activity Ceased
M = Ore being removed
S = Overburden only being removed
N = New mine unopened

Source: TWQB

Table V-2

Uranium Solution Mines
Activity as of September 1, 1975

Ownership	Mine Name	Location: County	Status
ARCO	Clay West	Live Oak	M
Westinghouse	Lamprecht	Live Oak	M
Westinghouse	Bruni	Webb	N
Mobil	O'Hern	Webb	N
DALCO	Clay West	Live Oak	MO
DALCO	Burns	Live Oak	P
Union Carbide	Palangana	Duval	P

Legend

M = Mining in Progress
MO = Mining Operations Ceased
N = New mine Unopened
P = Proposed mine, No Application Received by TWQB

Source: TWQB

The only uranium mill processing ore from open pit mines currently in operation in South Texas is the Conquista Project mill at Deweesville, Texas.

VI. REGULATIONS

General

The discharge of wastes to surface or ground waters from uranium mining and milling operations, whether by design or accident, is subject to a number of State and Federal regulations.

When open pit mining for uranium began in South Texas in 1960, it was essentially unregulated, at least from an environmental standpoint. The U.S. Atomic Energy Commission (now called the Nuclear Regulatory Commission) was heavily involved, since there was Federal interest in the early ores for national defense purposes and also interests in the health physics aspects of handling radioactive materials. In addition, the Texas State Department of Health (now called the Texas Department of Health Resources) was and is now the State agency designated by the U.S.N.R.C. to license operations involving radioactive materials.

The initial environmental monitoring in the South Texas uranium mining area was performed by the Texas Department of Health Resources in 1961 and 1962. Samples were obtained from the Atascosa River and the San Antonio River which drain the Karnes County mining area. This surface water sampling was conducted to determine whether the solution in the tailings ponds

at the newly opened processing mill at Deweesville was being leaked or leached into surface waters of the state.

In the mid 1960's sampling of privately owned wells was conducted in response to complaints and also to establish baseline quality of ground water in the area. All of this sampling was limited to radioactivity levels in these waters.

In addition, Susquehanna-Western, Inc. performed radioactive analyses of surface and ground waters in the area. The company data were in general agreement with the earlier Health Department findings.

Since that time to the present, TDHR routinely monitors both surface and ground waters for radioactivity.

Beginning in 1973, the Texas Water Quality Board placed into effect a registration program for uranium mining operations in accordance with Provisions of the Texas Solid Waste Disposal Act and the Texas Water Quality Act. This registration program was successful in stopping environmentally dangerous practices at older strip mines and insured that all subsequent mines would operate so as to minimize environmental damages. This registration program was reinforced and expanded with the promulgation of TWQB Board Order 75-0827-12 on August 27, 1975.

The Texas Water Quality Board also regulates uranium milling in situ solution mining operations with "no discharge" permits.

Since all uranium mining and milling operations in South Texas do not have discharges into the waters of the United States, no National Pollutant Discharge Elimination System (NPDES) Permits have been issued by the Environmental Protection Agency.

Applicable regulations are discussed below.

Texas Water Quality Standards

Texas Water Quality Standards apply to the surface waters of the state. The current standards were adopted by the Texas Water Quality Board pursuant to the authority contained in Sections 21.075 through 21.078 of the Texas Water Code (60th Legislature, Chapter 313, Sections 3.14 through 3.17, as amended by House Bill 343 during the regular session of the 62nd Legislature in 1971.

The discharge of radioactive materials is addressed by Section VI, General Criteria, of the standards as follows:

> There shall be no discharge of radioactive materials in excess of that amount regulated by the Texas Radiation Control Act, Article 4590(f), Revised Civil Statutes, State of Texas and Texas Regulation for Control of Radiation.

Radioactivity levels in the surface waters of Texas, including the radioactivity levels in both suspended and dissolved solids for the years 1958 through 1960, were measured and evaluated by the Environmental Sanitation Services Section of the Texas State Department of Health in a report prepared for and at the direction of the Health Department by the Sanitary Engineering Research Laboratory at the University of Texas. The document is entitled, "Report on Radioactivity - Levels in Surface Waters - 1958-1960" pursuant to contract No. 4413-407 and is dated June 30, 1960. This document comprises an authoritative report on background radioactivity levels in the surface waters in the State and quite importantly sets out the locations where natural radioactive deposits have influenced surface water radioactivity. The impact of radioactive discharges that may be made into the surface waters of Texas will be evaluated and judgments made on the basis of the information in the report which was at the time made, and may still be the only comprehensive report of its kind in the nation.

Radioactivity in fresh waters associated with the dissolved minerals (measurements made on filtered samples) shall not exceed those enumerated in U.S. Public Health Service, Drinking Water Standards, revised 1962, or latest revision, unless such conditions are of natural origin.

Texas Water Quality Board Rules

Certain rules of the Texas Water Quality Board adopted on March 26, 1970 cover radioactivity as follows:

RULE 300.3 REGISTRATION OF CERTAIN INDUSTRIAL SOLID WASTE DISPOSAL ACTIVITIES: The registration procedure prescribed in Section 310 of this Chapter III applies to the "non-commercial on-property" disposal of industrial solid waste, whether disposal is by means of a sanitary landfill operation, incineration, composting, or other method. However, nothing in this chapter exempts or excuses any person from complying with the licensing requirements of the Texas State Department of Health for the disposal of radioactive material established in accordance with the Texas Radiation Control Act, Art. 4590f. As used in these rules, "non-commerical on-property" disposal refers to disposal of industrial solid waste which comes within Section 4 (f) of the Solid Waste Disposal Act; Section 4 (f) applies to disposal of industrial solid waste within the property boundaries of a tract of land owned and controlled by the owners or operators of the particular industrial plant, manufacturing plant, mining operation, or agricultural operation from which the waste results or is produced, and which tract of land is within fifty (50) miles from the plant or operation which is the source of the industrial solid waste, and which industrial solid waste is not collected, handled, stored, or disposed of with solid waste from any other source or sources. The procedure for registration also applies to other activities subject to the jurisdiction of the Board under the Solid Waste Disposal Act which, in the opinion of the Board following a review of the same, should be regulated under the registration system. The Board also may adopt regulations governing particular waste disposal activities otherwise subject to registration, as provided in Rule 300.4. All registrations are subject to the orders of the Board or the Executive Director, as authorized in these rules.

RULE 305.1 SUBMISSION AND PROCESSING OF APPLICATION:

(f) WASTE CONTAINING RADIOACTIVE MATERIALS: An application which involves the disposal of a defined waste containing radioactive materials shall be accomplished by a letter or other instrument in writing from the Texas State Department of Health, stating either that the applicant, or the person disposing of the defined waste containing radioactive materials who is served by the applicant, has a license from the Department governing the disposal of radioactive materials; or that the applicant or the person served by the applicant does not need such a license.

RULE 310.1 SUBMISSION AND PROCESSING OF REGISTRATION FORMS:

(e) WASTE CONTAINING RADIOACTIVE MATERIALS: A registration which involves the disposal of industrial solid waste containing radioactive materials shall be accompanied by a letter or other instrument in writing from the Texas State Department of Health, stating that the registrant has a license from the Department governing the disposal of radioactive materials, or that the registrant does not need such a license.

Texas Water Quality Board Permits

The TWQB issues "no discharge" permits to all uranium leaching plants in Texas. The Conquista Project Mill is regulated through a registration only. Copies of the registration for the Conquista Project Mill at Deweesville and the permit for the Atlantic Richfield, Clay West Plant are included in Appendix B.

Texas Department of Health Resources Uranium Milling Licenses

The TDHR issues licenses controlling use, possession or transfer of source material under authority from the U.S. Nuclear Regulatory Commission through U.S. Regulation 10CFR20. Source materials are defined as ores which contain more than 0.05% of combined uranium and thorium. Under the regulation, all ion-exchange plants and uranium mills are licensed by the TDHR.

The regulations set forth the maximum concentration of various radionuclides which are permitted in effluents to "unrestricted areas". An unrestricted area is defined as any area to which access is not controlled by the licensee to protect individuals from exposure to radiation and radioactive materials. Personnel badge monitoring is not required in unrestricted areas. The maximum allowable concentration of radium-226 in a water effluent to an unrestricted area is 30 pCi/l. All uranium mills and ion-exchange plants are controlled by this regulation from the initial start-up of the facility.

Drinking Water Requirements

The Texas Department of Health Resources controls and approves public water supplies in Texas. Individual residential sources used for private consumption are not controlled, however, the TDHR advises as to the quality of the

water in such sources.

With the passage of the Safe Drinking Water Act (PL 93-523, Dec. 16, 1974) Federal control is extended to cover many drinking water supply systems. Previously only those systems used in interstate commerce were required to meet USPHS Drinking Water Standards. The latest issue of the USPHS Standards set a limit of 3 pCi/l for radium-226, and 0.01 mg/l for selenium.

The Safe Drinking Water Act applies to all public systems supplying water to fifteen service connections or at least 25 individuals unless the system is exempted by four specific criteria.

As required by Sections 1412, 1414, 1415, and 1450 of the Safe Drinking Water Act, the EPA Administrator, on March 14, 1975, proposed Interim Primary Drinking Water Standards. These proposed regulations included a limit of 0.01 mg/l selenium. The Interim Primary Drinking Water Standards are to be promulgated within 180 days of the enactment of the Act, and they become effective 18 months after their promulgation, or Dec. 1977. The EPA has proposed standards of 5 pCi/l radium (226-228) and 15 pCi/l gross alpha (exclusive of uranium) under the Act.

Texas Strip Mining Legislation

Legislation which controls and regulates exploration for and mining of certain minerals, including uranium, and which requires reclamation of land disturbed by mining operations was signed into law on June 21, 1975

The "Texas Surface Mining and Reclamation Act," effective January 1, 1976, exempts any surface mining operation which is conducted on public lands regulated by the General Land Office, and any land where the "overburden" has been removed and any minerals have been mined prior to the bill's enactment. The law defines overburden as all materials displaced in a mining operation which are not, or will not be, removed from the affected area.

The Railroad Commission of Texas is responsible for setting rules and regulations pursuant to the Act's provisions, as well as the permit issuance authority. Regulations have been drafted and are scheduled for public hearing on November 5, 1975. The commission is required also to inspect periodically surface mining and reclamation operations.

Reclamation plans proposed to the commission must be developed in a manner consistent with local, physical environmental, and climatological conditions and current mining and reclamation technologies.

Reclamation standards require that the operator conduct surface mining operations in a manner consistent with prudent mining practice and restore the land affected to the same or a substantially beneficial condition considering the present and past uses of the land.

Operators must take steps to avoid endangering public health or posing an actual or probable threat of water diminution or pollution.

The standards state also that persons conducting surface mining operations reduce all highwalls, spoil piles, and banks to a degree to control erosion effectively, stabilize and protect all surface areas affected to control erosion and attendant air and water pollution, and avoid deterioration of the topsoil.

Surface mining permits will be denied if the commission finds that the reclamation as required by the state cannot be accomplished by means of the proposed reclamation plan, if any part of a proposed operation lies within an area designated as unsuitable for surface mining, or if the commission determines the mining operation will endanger public health.

Before a permit is issued, an applicant must file a bond covering that area of land within the permit area on which the operator will conduct mining operations.

The amount of the bond depends on the reclamation requirements of the approved permit and shall be determined by the commission on the basis of at least two independent estimates.

The amount of the bond also shall be sufficient to assure completion of the reclamation plan if the work has to be performed by a third party in the event of forfeiture.

The commission must issue notices and may conduct hearings on applications for permits.

Violators of provisions of the act are subject to penalties of $5,000 for each day of violation.

The legislation establishes a special Land Reclamation Fund. All funds received through the payment of fees, loans, grants, penalties, and bond forfeitures shall be placed in the fund, which will be used for administering and enforcing the surface mining act and for claiming lands affected by surface mining operations.

VII. WATER QUALITY OF THE STUDY AREA

General

The South Texas uranium mining area can be considered water short, and the waters that are available from surface sources and relatively shallow aquifers can be classified as marginal from both a quality and quantity standpoint.

Public as well as private drinking water in the area is supplied from wells. Stock water is supplied from both wells and surface stock ponds and irrigation water is generally supplied from deep wells. Potable water at the one operating uranium mill, the Conquista Project at Deweesville, is piped in from the rural community water supply serving the area. Potable water at the Arco Leach Plant at George West is supplied from a company owned deep well.

Routine monitoring of surface and ground waters for normal chemicals as well as radioactive constituents has been carried on in the area for a number of years by several agencies as well as private interests. Table VII-1 summarizes the data sources, the time horizon of the monitoring, and analyses performed.

Table VII-1

Summary of Surface and Ground Water Monitoring Data*
South Texas Uranium Mining Area

Source Agency	Number of Stations	Time Horizon	Total Number of Samples	Parameters Analyzed
Flowing Surface Streams				
USGS	4	1968-75	300	Normal USGS Q.W. Spectrum
TWQB	1	1974-75	2	Arsenic, Molybdenum, Selenium
TDHR	20	1961-72	74	Radioactivity (α,β)
Impoundments (Mine pits and Tailings Ponds)				
TDHR	20	1971-72	31	Radioactivity (α,β)
TWQB	10	1974-75	11	Chemical including As, Mo and Se
Conquista Project	14	1975	14	pH, Arsenic, Molybdenum, Selenium
Itin, et al. U.T. Health Science Center Houston	12	1973	16	Chemical analyses, Radioactivity, Biological
Groundwaters				
TWDB	24	1936-73	33	Chemical analyses
TDHR	77	1963-72	89	Radioactivity (α,β)
TWQB	16	1974-75	16	Arsenic, Molybdenum, Selenium

* The numbers in this table are the representative data considered by EPA during this investigation and may not be inclusive of all data available.

Surface Waters

The mined portion of the South Texas uranium mining area is drained by the San Antonio and Nueces River basins. Chemical data from U. S. G. S. Quality of Water Stations on the San Antonio River near Falls City and on the Nueces River at Three Rivers are typical of waters in the area and show no alteration of chemical quality that can be attributed to leaching from uranium mining or milling operations throughout the period of record (1968-1974) examined.

Similarly two TWQB grab samples on the San Antonio River near Falls City taken for toxic metals analysis (arsenic, molybdenum and selenium) during 1974, indicate negative results (i.e. all three of these metals are below their detectable limits: arsenic <0.005 mg/l; molybdenum <0.5 mg/l; and selenium <0.001 mg/l).

Radioactivity analysis for surface streams in the area taken by the TDHR, indicate generally low gross alpha, gross beta, radium 226 and uranium 238 concentrations.

There is one stream in the area that exhibited considerably higher radioactivity than all others. This is Sulfur Creek in Live Oak County, a tributary of the Nueces River which enters the Nueces River near Oakville, Texas. Samples were taken by TDHR during and after a reported discharge of mine water in 1971-72. During the discharge gross alpha concentrations as high as 1,450 pCi/l, gross beta concentrations

as high as 530 pCi/l, radium 226 concentrations as high as 90.2 pCi/l, and uranium 238 concentrations as high as 1,138 pCi/l were recorded. After the discharge was contained in late 1971, the activity also dropped. Due to the small flow in Sulfur Creek, the effects of this discharge on the Nueces River were neglibible.

Table VII-2 summarized the available data on surface waters in the area.

Ground Water

Ground water quality both chemical and radiochemical in the area is highly variable. Extensive data collected by the State agencies indicate that wells, even when spaced only a few hundred yards apart and producing from the same depth, exhibit marked differences in quality. Such variations are typical and are due to the small size and sharp boundaries of the uranium ore bodies found in South Texas.

The occurrence of the commonly measured chemical constituents in this area is well known and can be obtained from publications of the Texas Water Development Board. These are not discussed in this report because cursory examination of these data, compared to similar data obtained as a requirement for mine registration by TWQB indicate that there is no correlation between mining activity and these water quality indicators.

Table VII-2

Summary of Surface Water Quality Data - South Texas Uranium Mining Area

Station Description	Number of Samples	Total Dissolved Solids (mg/l) Max.	Min.	Avg.	As mg/l Avg.	Mo mg/l Avg.	Se mg/l Avg.	Radioactivity: Gross α pCi/l Max.	Min.	Avg.	Gross β pCi/l Max.	Min.	Avg.
San Antonio R.	24	544	84	384	---	---	---	---	---	---	---	---	---
nr. Falls City	2	---	---	---	0.005	0.5	0.001	---	---	---	---	---	---
	12	---	---	---	---	---	---	4	1	2	82	1	19
Nueces R. nr. Three Rivers	22	1500	186	862	---	---	---	3	2	3	28	8	18.5
	6												
Nueces R. nr. George West	8	---	---	---	---	---	---	4	2	3	22	9	15.8
Atascosa R. nr. Campbellton	9	---	---	---	---	---	---	3	1	2	79	3	22.8
Sulfur Creek at First FM 1358 Crossing	5 (Entire Record)							1450	8	475	530	25	160
	2 (During Discharge from mine)							1450	860	1155	---	--	530
	3 (After control of mine Discharge)							44	8	22	53	25	36

Source: USGS, TWQB, TDHR

Radiochemical ground water quality also appears not to suffer from mining activity, but rather its variability appears due to natural conditions. Movement of ground waters in the area varies from a few centimeters to several meters per year. In general, wells drilled in close proximity to ore bodies, or actually into ore bodies in some instances, reflect much higher activity than wells further away.

TDHR data on 44 private wells during the period 1963-1972 indicate average alpha and beta activity of 18 pCi/l and 45 pCi/l respectively. Similarly the maximum activities were 147 pCi/l alpha and 525 pCi/l beta. Radium 226 concentrations on these wells averaged 9 pCi/l and the maximum recorded was 153 pCi/l.

TDHR data on 22 minicipal water supplies in the area is much lower. The average alpha and beta activities were <2 pCi/l and 14 pCi/l respectively while the maximum activities were 2 pCi/l alpha and 28 pCi/l beta. Radium 226 concentrations measured in 10 of these supplies averages <1.5 pCi/l and the maximum recorded was <2 pCi/l.

Since arsenic, molybdenum and selenium occur in varying amounts in the same areas as the uranium ores of South Texas, and since these metals are all toxic, concern over increases in concentrations of these metals in ground waters due to uranium operations has been raised. While the data are not nearly as extensive as the radiochemical and common chemical data, samples collected in 1974 by the TWQB in 15 private

producing wells in close proximity to uranium mines indicate the following:

Concentration (mg/l)	Arsenic	Molybdenum	Selenium
Maximum	0.087	<0.5	0.015
Minimum	<0.005	<0.5	<0.001
Average	0.019	<0.5	0.005

1973-74 data on quarterly analysis of monitoring wells required by TWQB and submitted by the Conquista Project on their active mines showed arsenic concentrations averaging 0.01 mg/l in 1973 and 0.03 mg/l in 1974. Molybdenum concentrations for 1973 and 1974 were 0.45 mg/l and 0.17 mg/l respectively.

Open Pit Mine Water

Since essentially all but the early mined oxidized ores occur below the water table, ground water seeps into the mine pits. These waters vary in quality between mines. Again the radiochemical and chemical qualities vary widely.

1971-72 TDHR radiochemical data on 9 of these mine ponds show alpha activity varying between 6 and 4,674 pCi/l and averaging 1,215 pCi/l. Beta activity ranged from 21 to 6,150 pCi/l and averaged 1,487 pCi/l.

As far as toxic metals go, the TWQB found that from 9 samples collected in 1975 these metals existed in the following concentrations in mine pit waters.

	Concentration (mg/l)		
	Max.	Min.	Avg.
Arsenic	0.041	<0.01	0.018
Molybdenum	<0.5	<0.5	<0.5
Selenium	0.054	0.005	0.022

In his Master's thesis, submitted to the University of Texas Health Science Center at Houston in March 1975, S. C. Itin investigated the suitability of using the waters impounded in abandoned mine pits for various legitimate water uses.

He chose 10 abandoned mine pits plus two stock ponds adjacent to uranium mill tailings areas for his study. Based on chemical and radiochemical parameters, he found all except one of the sites to be unsuitable for most purposes. Samples in the deeper pits were taken at several depths. No significant variation in the parameters analysed due to stratification was noted.

It is interesting to note that the site found suitable for drinking, recreating, irrigating, stock and wildlife watering and for fish and aquatic life was a pond adjacent to a tailings area at the abandoned Susquehanna-Western, Inc. Mill at Deweesville.

Runoff from Mine Areas

The data on chemical quality of water running off from mining areas are very sparse and radiochemical data are non-existent.

One sample from a Conquista Project mine described as "Rain Runoff" before stripping showed an arsenic and molybdenum concentration of 0.01 mg/l and <0.20 mg/l respectively. Another sample labeled "Rain Runoff" during mining had concentrations of 0.009 mg/l arsenic and 0.15 mg/l molybdenum. Two additional runoff samples were in the same range.

Runoff from early uncontrolled mining operations can result in a substantial environmental impact, however. First of all, drainage from an ore pad that has not been completely removed can result in pollution of surface waters from toxic metals (Mo, Se, As) and radioactivity since oxidation of the ore makes the uranium and some of its daughter products soluble. Similarly erosion from the overburden pile(s) results in silt plus some of the same toxic metals pollution. For instance, crystallized molybdenum (moly blooms) on the order of one foot in diameter were clearly visible in large numbers on the exposed faces of overburden piles at one of the Weddington mines in Karnes County.

Molybdenum in this form is highly soluble and is a cause for concern since it is easily taken up by native grasses in

the area which are grazed by cattle. Ingestion of these grasses by the cattle results in molybdenosis, a disease which is characterized by diarrhea, weight loss, hair depigmentation and stiffness of the back and legs in young animals. It can also cause loss of libido and reproductive capability in males. A significant number of dairy cattle on a ranch in Karnes County were reported as exhibiting this syndrome in March 1972. It was reported as being aggravated by apparent molybdenum leaching from several small uranium mines on the ranch property.

Solution Mining and Water Quality

Since this mode of uranium recovery in South Texas is relatively new, and mining companies as well as regulatory agencies are feeling their way, very little about the effects of these operations on water quality in the area is known.

The TWQB policy of requiring monitor wells surrounding the "pattern" and above as well as below the ore formation appears adequate. In theory, if leachate is found in a monitor well, appropriate changes in the pumping and injection plan will reverse the trend and bring the surrounding formation back to a pre-mined condition. Such a breakthrough of leachate has occurred in two operating solution mines in Live Oak County (Wyoming Mineral and Atlantic Richfield). The results of corrective actions taken on the surrounding formation water quality is not known at this time.

VIII. EFFECTS OF URANIUM MINING ON AIR QUALITY

General

No data on the effects of open pit uranium mining on air quality in the area are available, however, it is clear that windblown particulates from overburden piles and old remnants of ore pads plus fugitive emissions generated during the mining and ore hauling processes cause air pollution problems and probably result in some intermedia transfer of pollutants in varying degrees.

The relative dry climate of the area coupled with the inability of the overburden to support vegetation result in particulate emissions from open pit mines. It has been said that particulate fallout from the mining area has been detected as far as the Connally Ranch West of Floresville, Texas, some 34-35 air kilometers away. No data to substantiate this claim were found, however.

Ore hauling operations release particulate emissions probably to some extent from the ore being hauled in open dump trucks but especially from the denuded mine areas and dirt haul roads between the mines and the mill site.

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APPENDIX A

TEXAS WATER QUALITY BOARD
P. O. Box 13246, Capitol Station
Austin, Texas 78711

ORDER NO. 75-0827-12

AN ORDER of the Texas Water Quality Board under the authority of the Solid Waste Disposal Act and the Texas Water Quality Act adopting regulations for the disposal of wastes associated with uranium mines and prevention of water pollution from uranium mines and directing the Executive Director to send copies of this order to those persons who may be reasonably affected by it.

PREAMBLE

Improperly conducted uranium mining operations can cause several types of environmental harm which are under the purview of the Texas Water Quality Act and Solid Waste Disposal Act. They may cause degradation of both surface waters and groundwaters. Improper disposal of overburden and other solid mining wastes may cause damage to the property of others, public property, rights-of-way and other rights requiring protection.

The problems associated with uranium mining lend themselves to regulation by general rules. Pollutants from the mines can be confined to the mining area by following procedures prescribed in the regulations adopted by this order. Damage to property of others, public property, rights-of-way and other rights requiring protection, which might be caused by improper disposal of mining wastes, can be adequately controlled by the regulations adopted by this order. The in situ leaching process for the extraction of uranium ore is a relatively new development and differs in essential respects from surface and deep mining methods. Therefore, the attached regulations do not cover in situ leaching process mining, which will continue to be handled on an individual permit basis. This order and the attached regulations are adopted in full recognition of the enactment of the Texas Surface Mining and Reclamation Act (Senate Bill 55, Acts of the 64th Legislature, Regular Session, 1975) and are not intended to overlap or to conflict with the Act. At the request of the Texas Railroad Commission

staff, this Order does apply to uranium mining operations begun (ore removed) or proposed between the enactment date and effective date of the Surface Mining Act, with provision for the transfer of data and control to the Commission after the effective date of the Act. Now, therefore,

BE IT ORDERED BY THE TEXAS WATER QUALITY BOARD:

1. Under the authority of Article 7621d-1 and Article 4477-7, Vernon's Texas Civil Statutes, the regulations pertaining to uranium mining operations and disposal of pollutants and solid wastes therefrom attached to this order are hereby adopted for statewide implementation.

2. The regulations adopted by this order shall not be construed in such a manner as to conflict with the Texas Surface Mining and Reclamation Act or with any regulations adopted pursuant thereto.

3. Any operator of a uranium mining operation within the State of Texas from which any ore has been removed on or before the effective date of this order is directed to register the mining operation in accordance with the uranium mining regulations by October 1, 1975 and to immediately comply with the regulations effected by this Order. Any person proposing to open a uranium mining operation subsequent to the effective date of this order and prior to January 1, 1976 is directed to register the proposed operation in accordance with the regulations and to comply with said regulations.

4. Permits, Waste Control Orders, Registrations or other authorizations for uranium mining activities previously issued by the Texas Water Quality Board remain in effect until October 1, 1975 unless changed to a uranium mining registration on motion of the regulated party following acceptance of any conditions imposed by the Executive Director necessary to bring the operation into compliance with the uranium mining regulations and Rules of the Texas Water Quality Board.

5. All information submitted to the Texas Water Quality Board pertaining to uranium mining operations begun (ore removed) or proposed subsequent to June 20, 1975 shall be transmitted to the Texas Railroad Commission after January 1. 1976 for the Commission's use in regulating said operations.

6. If any provision of this order or of the attached regulations or the application thereof to any persons or circumstances is held invalid, such invalidity shall not affect other provisions or applications of the order and/or regulations which can be given effect without the invalid provision or application, and to this end the provisions of this order and regulations are declared severable.

7. The Executive Director is directed to implement these regulations, and to send copies of this order and the attached regulations to all persons whom he has reason to believe they may affect.

Passed this 27th day of August, 1975.

TEXAS WATER QUALITY BOARD

J. Douglass Toole, Chairman

(Seal)

ATTEST:

Hugh C. Yantis, Jr., Executive Director

TEXAS WATER QUALITY BOARD
P. O. Box 13246, Capitol Station
Austin, Texas 78711

REGULATIONS CONCERNING WATER POLLUTION AND SOLID WASTE DISPOSAL ASPECTS OF URANIUM MINING OPERATIONS

CHAPTER I. DEFINITIONS

SECTION 1.01. DETAILED MEANINGS OF TERMS

For the purpose of these regulations, the definitions of terms used in the regulations are those provided in Rule 100.1 of the Rules of the Texas Water Quality Board. In addition, the Board ascribes the following meanings to the following additional terms:

(a) "Uranium ore" means the assemblage of minerals taken from the mine from which uranium compounds are extracted;

(b) "Ore pad" means that area used for the temporary deposit of ore as it is removed from the mine and before it is transported elsewhere for processing;

(c) "Overburden" means all of the earth and other materials which overlie the deposits of uranium ore, and includes all earth and other materials disturbed from its natural state in the process of mining;

(d) "Uranium mining" means the removal of uranium ore from ore deposits. It includes both surface and underground mining techniques; and

(e) "Operator" means any person, firm, partnership, association or corporation engaged in or controlling one or more uranium mining operations in the State of Texas.

CHAPTER II. APPLICATION OF REGULATIONS

SECTION 2.01. APPLICATION OF REGULATIONS

These regulations apply to the disposal of waste and the control of water pollution from any and all types of uranium mining operations except in situ mining which involves extraction of uranium by solutions injected into the ore body.

CHAPTER III. REGISTRATION OF URANIUM MINING OPERATIONS

SECTION 3.01. PERSONS REQUIRED TO REGISTER

Every operator conducting one or more uranium mining operation is required to register each operation in accordance with these regulations on or before October 1, 1975, and every operator proposing to begin removal of overburden from a new uranium mining operation on or before December 31, 1975 shall register the proposed operation prior to removing any overburden.

SECTION 3.02. OPERATIONS BEGUN UNDER PRIOR AUTHORIZATION

Operators conducting uranium mining operations under Permits, Waste Control Orders, Registrations or other authorizations issued by the Texas Water Quality Board prior to the effective date of these regulations may continue to operate under the prior authorization until October 1, 1975, after which time registration under these regulations is required. Such application or authorizations can be changed to a uranium mining registration on motion of the operator following acceptance of any conditions imposed by the Executive Director necessary to bring the operation into compliance with these regulations and the Rules of the Texas Water Quality Board.

SECTION 3.03. REGISTRATION PROCESS

The process for properly registering a uranium mining operation is as follows:

(a) The operator must submit to the Texas Water Quality Board, all information required by these regulations; and

(b) The Executive Director or staff acting under his direction will review the request and any accompanying maps, data, information and materials. The Executive Director or staff acting under his direction may request any additional information reasonably required for an adequate understanding of the operation, and the operator must provide such information.

SECTION 3.04. REGISTRATION BASED ON INCORRECT INFORMATION

If any operator registering a uranium mining operation knowingly submits materially incorrect information, any registration recorded as a result of such submission shall be void ab initio.

SECTION 3.05. TRANSFER OF REGISTRATION

Registration is granted in personam, does not attach to the operation or realty to which it relates, and may be transferred in accordance with Section 415 of the Rules of the Texas Water Quality Board.

SECTION 3.06. APPEAL TO THE BOARD

Any person aggrieved by any action taken by the Executive Director in entering, transferring, or terminating any registration, or in refusing to do so, may appeal to the Board in accordance with the procedures established in Rule 600.2 of the Rules of the Texas Water Quality Board. Appeal to the Board shall be prerequisite to judicial appeal.

CHAPTER IV. ENFORCEMENT AND TEMPORARY ORDERS

SECTION 4.01. ENFORCEMENT

Adherence to these regulations by all operators of uranium mining operations shall be enforced in the manner and by the means set out in the Texas Water Quality Board Enforcement Policy.

SECTION 4.02. TEMPORARY ORDERS

Nothing in these regulations may be construed to preclude the Executive Director or the Texas Water Quality Board from issuing a Temporary Order directing an operator to take any necessary corrective action, including an order to cease any activity,

at any time it reasonably appears that the result of any mining activity is pollution or threatened pollution of the waters in the State or is significant damage to or a significant threat to damage the property of others, public property or right-of way, or other rights requiring protection.

CHAPTER V. INFORMATION REQUIRED TO BE SUBMITTED WITH EACH REGISTRATION

SECTION 5.01. MAPS AND VIEWS

Each registration shall include:

(a) A U. S. Geological Survay Map of a scale of 1:24000 showing the location and size of the mining operation, the location of all other uranium mines, including in situ mines within a five (5) mile radius of the mining operation, and the location of background sample points;

(b) A plan-view of the mining operation detailing and dimensioning each existing or intended major feature of the mine, including over-burden, ore pad, diversion dikes or ditches, holding ponds, contours on ten (10) foot intervals, and identifying adjacent landowners; and

(c) Cross-sectional views detailing the overall mine, surface water diversion, ore pad and holding ponds.

SECTION 5.02. GROUNDWATER AND WATER WELL INFORMATION

Each registration shall include:

(a) The depth to the shallowest groundwater table and to any perched waters;

(b) A list of all water wells within 500 feet of the mine; with the following information for each: location, depth, use, age, and whether completed with or without casing; and

(c) A list of all domestic and stock wells or exploratory holes from which water samples will be taken to establish baseline data required in Section 6.02(a) with the following information for each: location, depth, use, age, if a source is a well, whether completed with or without casing, and the name of owner. Locations shall be indicated on appropriate plan-views and maps.

SECTION 5.03. ORE BODY

Each registration shall include a description of the depth, thickness and estimated area of ore body to be mined.

SECTION 5.04. SCHEDULES

Each registration shall include estimated schedules for removal of any remaining overburden, removal of ore, and closing the mine.

SECTION 5.05. POLLUTION CONTROL

Each registration shall include the following pollution control information:

(a) A proposed plan for accomplishing the stabilization of overburden required by these regulations;

(b) A description of the means contemplated or in use for diverting the flow of surface runoff waters around minesite activities and minimizing runoff away from the minesite onto adjacent properties;

(c) Engineering Data documenting the capacity of catch basins and holding ponds, as required in Section 6.01.(a), to contain or control the expected volumes of rainfall runoff from a 5-inch/24-hour rainfall and waters pumped from the mine floor; and

(d) A description of operator's maintenance-restoration capacity including: number of personnel and itemization of major items of equipment, including size and type.

SECTION 5.06. COMPLIANCE WITH THE TEXAS RADIATION CONTROL ACT

Each registration shall include an affidavit from the applicant stating that the operator has been issued all necessary licenses

and registrations required under the authority of Article 4590f, Texas Radiation Control Act, and that the operator is in compliance with all applicable rules, regulations and orders of the Texas Department of Health Resources promulgated under the authority of the Act.

SECTION 5.07. NOTIFICATION OF ADJACENT LANDOWNERS

Operators opening mines on or after the effective date of this regulation shall submit the following information:

(a) Names and addresses of the owners of the surface contiguous to the proposed mining operation, and the operator's source of this information; and

(b) Certification that the above owners have been notified in writing of the operator's plan to open the proposed uranium mine.

CHAPTER VI. PROTECTION OF SURFACE WATER AND GROUNDWATER

SECTION 6.01. PROTECTION OF SURFACE WATER

The operator shall provide sufficient protection of surface waters as follows:

(a) From the effective date of these regulations until completion of ore removal, the operator shall take adequate measures to insure that rainfall runoff from the overburden will be drained into an adequately sized holding pond, catch basin, to the mine, or to adjacent mines.

After completion of ore removal, rainfall runoff from the overburden shall be drained into the pit or otherwise controlled until erosion control is established. Techniques that the operator may utilize to accomplish the above include, but are not limited to:

(1) grading of the overburden and the ore pad;
(2) reliance upon the existence of natural grading in the area; and
(3) the construction of ditches, dams, or berms;

(b) Any discharge of rainfall runoff from the holding facilities shall be subject to the following limitations:

(1) Concentrations of arsenic, molybdenum and selenium on a grab sample, shall not exceed concentrations established as baseline groundwater quality in accordance with Section 6.02(a);

(2) pH shall not be less than 6.0 or greater than 9.0; and

(3) Total Suspended Solids shall not exceed 50 mg/l on a daily average, or 150 mg/l on a grab sample;

(c) External slopes of the overburden will be shaped to minimize runoff and to provide a surface to be seeded;

(d) Runoff from the ore pad shall not be allowed to leave the minesite; and

(e) During the mining operation, all water pumped from the ore zone is to be retained in a holding pond located in the minesite area.

SECTION 6.02. PROTECTION OF GROUNDWATER

To avoid significant contamination of groundwater, the following measures will be taken by the operator for each mine:

(a) Prior to beginning overburden removal for any new mine and on or before October 1, 1975 for any area presently being mined, baseline groundwater quality shall be established by analysis of groundwater samples obtained from no less than six (6) domestic wells or bore holes located symetrically around the mine and within 500 feet of the mine, or by another method acceptable to the Executive Director or designated staff of the Texas Water Quality Board. Baseline groundwater quality shall be described in terms of the following water quality parameters: pH, molybdenum, selenium, and arsenic. The operator shall arrange with the Texas Water Quality Board to have staff personnel present during sampling to establish sampling points and procedures, and analysis procedures;

(b) If at any time during mining or closing operations, ponding of water occurs in or below the ore strata level, samples of the ponded water shall be taken, analyzed and compared to the baseline groundwater concentrations immediately and subsequently at quarterly intervals; and

(c) The operator shall submit to the appropriate District Office of the Texas Water Quality Board each analysis required by subsections (a) and (b) above as it is completed. If the quality of the ponded water samples establishes a deteriorating trend, as determined by the Texas Water Quality Board staff, or is determined to be of significantly poorer quality than the baseline groundwater quality, the operator shall take all appropriate action to correct the deterioration and prevent recurrence of the conditions causing the deterioration. A log of events describing corrective actions taken and charts of all sample analyses shall be maintained before and during this corrective period and made conveniently available to the Texas Water Quality Board staff.

CHAPTER VII. MAINTENANCE, STABILIZATION, AND CLOSING OPERATIONS

SECTION 7.01. MAINTENANCE

Disturbed soils tend to erode and for this reason the operator is encouraged to backfill overburden in the active or adjacent inactive mines, where reasonably possible. Because of the tendency of disturbed soil to erode and for facilities such as dikes, ditches, and catch basins to collect silt during rains, the operator shall prepare and carry out a maintenance program covering the entire area included in all operations conducted by the operator, as follows:

(a) Once every two months the operator shall inspect all waste control facilities at all operations and shall submit a maintenance report to the Texas Water Quality Board. The report shall list any significant corrective work required for control facilities, including those repairs which cannot be accomplished in two (2) days by the full effort of the crew and equipment designated for the purpose of repair and closing activities. The

report shall list, in order of priority, the corrective and closing work required, and state the expected completion dates. This maintenance schedule is subject to approval by the Executive Director or designated staff personnel. A schedule is acceptable if it provides for timely accomplishment of the requirements of Section 6.01 and 6.02. The operator shall proceed with maintenance work according to the submitted schedule until advised by the Executive Director to revise the schedule;

(b) Failure to accomplish, without good cause, maintenance operations in accordance with the submitted or revised maintenance schedule shall be deemed a violation of this regulation; and

(c) The maintenance program shall continue until the mining operation is closed, as defined in Section 8.01.

SECTION 7.02. STABILIZATION OF OVERBURDEN

The following procedures shall be carried out by the operator within six (6) months of the time that ore removal has commenced:

(a) The overburden shall be seeded in accordance with a plan submitted by the operator and approved by the Executive Director or designated staff. This plan shall provide for vegetative cover which:

(1) is capable of self-regeneration and plant succession; and

(2) is at least equal in extent of cover to the natural vegetation of the area;

(b) To facilitate the establishment of vegetative cover currently recognized agricultural and horticultural techniques may be required to establish vegetation; and

(c) The Executive Director may approve an extension of time for commencement of these procedures after application by the company for such extension and a showing of good cause.

SECTION 7.03. CLOSING OPERATIONS

The following procedures shall be carried out by the operator immediately upon completion of mining activities:

(a) The ore pad shall be scraped and wasted into the pit;

(b) If the pit is backfilled to a level such that ponding of water does not occur, the overburden in the pit shall be stabilized in accordance with the requirements of Section 7.02 above; and

(c) Any remaining overburden not backfilled into the pit shall be stabilized in accordance with the requirements of Section 7.02 above.

CHAPTER VIII. RELEASE FROM REQUIREMENTS OF THESE REGULATIONS

SECTION 8.01. RELEASE

At such time as the operator demonstrates all of the following to the Executive Director or designated staff:

(a) That all requirements of Section 7.03, Closing Operations have been met;

(b) That all vegetative cover required under Section 7.02 and 7.03 has sustained itself without fertilization or irrigation for a period of two (2) years; and

(c) That the quality of any ponded waters is stable and has not significantly deteriorated for a minimum period of two (2) years; then

the mining operation will be considered closed for the purposes of these regulations; the operator will be released from further responsibility for activities and reports required by these regulations; and the operator will be so notified in writing by the Executive Director.

CHAPTER IX. WASTE DISPOSAL WELLS

SECTION 9.01. EXCLUSION FROM THESE REGULATIONS

Disposal wells are specifically excluded from coverage under these regulations. Any operator proposing to dispose of waste

incurred through uranium mining operations by use of a disposal well must apply for and receive a separate permit for any such disposal well under the provisions of Chapter 22, Texas Water Code.

CHAPTER X. COMPLIANCE, SEVERABILITY AND EFFECTIVE DATE

SECTION 10.01. COMPLIANCE

Any request for registration, action, procedure, or operation under these regulations shall be in accordance with the Rules of the Texas Water Quality Board.

SECTION 10.02. SEVERABILITY

If any provisions of these regulations or the application thereof to any person or circumstance is held invalid, such invalidity shall not affect other provisions or applications of these regulations which can be given effect without the invalid provision or application, and to this end the provisions of these regulations are declared severable.

SECTION 10.03. EFFECTIVE DATE

These regulations become effective on August 27, 1975.

APPENDIX B

MAY BE OBTAINED BY CONTACTING S&A DIV, EPA,
DALLAS, TEXAS.